Stokes' theorem

$$\oint H.dL = \int_S (\nabla \times H).ds$$

$$= I = \int_S \bar{J}.ds$$

$\bar{J}$ ← Current density

$$\boxed{\nabla \times H = J} \Rightarrow 3^{rd} \text{ maxwell's equation}$$

$$\oint E.dL = \int_S (\nabla \times E).d\mathbf{s} = 0$$

$$\boxed{\nabla \times \bar{E} = 0} \Rightarrow \text{For steady state equations}$$

$$\int_S D.ds = \int_S (\nabla . D) d_v = \int_v \rho_v \, dv$$

Divergence relation

$$\boxed{\nabla . \bar{D} = \rho_v} \quad 1^{st} \text{ maxwell's equation}$$

$\bar{J}$ (general)

Conduction — displacement — Convection

نستخدم معادلات (maxwell) للتعرف على أوجه الكهرومغناطيسية.

7.5 Magnetic Flux and Magnetic Flux density.

$$\bar{B} = \mu \bar{H}$$

μ = Permeability ⇒ قدرة المادة على إمرار الفيض المغناطيسي خلالها

$= \mu_o \mu_r$

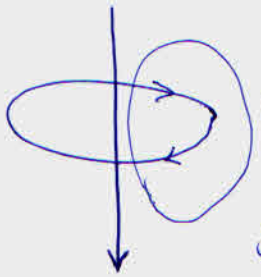
μ_o = Absolute Permeability

$= 4\pi \times 10^{-7}$

μ_r = Relative Permeability

$= 1$ For non magnitic materiales or (Ferrite materials)

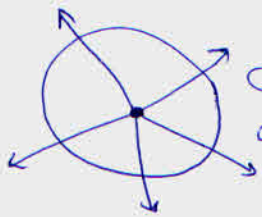
* $\oint_S B \cdot ds = 0$



دائماً أحمال مغناطيس حول سطح مغلق يساوي صفر لأنه في Loop

$$\int_v (\nabla \cdot B)\, dv = 0$$

$$\boxed{\nabla \cdot \bar{B} = 0} \Rightarrow 2^{nd} \text{ maxwell's equation}$$



- أحمال الكتروني ببروج لا ∞

* Maxwell's equation (Divergence relations)

① $\nabla \cdot \bar{D} = \rho_v$

$= 0$ iF $\rho_v = 0$

② $\nabla \cdot \bar{B} = 0$

Curlling equations

③ $\nabla \times H = J$ } ⇒ steady state equations

④ $\nabla \times E = 0$ }

ch. 8 Magnetic Forces, materials and Inductance:-

$$dF = dQ\, \bar{U} \times \bar{B}$$

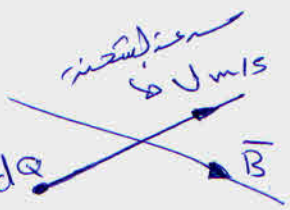
$$= \int_v dv\, \bar{U} \times \bar{B}$$

$$= \bar{J} \times \bar{B}\, dv$$

$$= (\bar{J}\, dv) \times \bar{B}$$

بقوة أو قوة Q بالشحنة

شحنة تتحرك في مجال مغناطيس بسرعة وتقاس منه قوة وانقوة كليل (F)



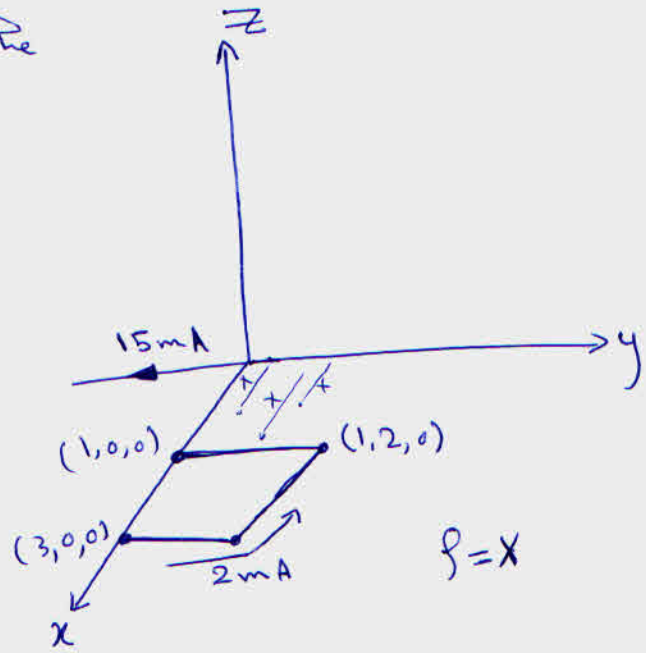
But: $J\, dv = K\, ds = I\, dL$

$$dF = \bar{J}\, dv \times \bar{B} = (\bar{K}\, ds) \times \bar{B} = \bar{I}\, dL \times \bar{B}$$

$$\boxed{F = \int_F \bar{I}\, dL \times \bar{B}}$$

1234

4.1/ For the Fig. shown, find the Force on the loop due to the current 15 mA



Sol/

$$\bar{F} = \oint \bar{I}\, d\bar{L} \times \bar{B}$$ ← قانون بيو سافارت

$$\bar{H} = \frac{I}{2\pi\rho}\bar{a}_\phi$$

$$= \frac{I}{2\pi x}\bar{a}_z = \frac{15*10^{-3}}{2\pi x}\bar{a}_z$$

$$\bar{B} = \mu_o \bar{H} = (4\pi*10^{-7})\frac{15*10^{-3}}{2\pi x} = \frac{3}{x}*10^{-9}$$

$$\bar{F} = \int_L \bar{I}\, d\bar{L} \times \bar{B} = \int_{x=1}^{3} (2*10^{-3})\, dx\, \bar{a}_x \times \bar{B} + \int_{y=0}^{2} \cdots + \int_{x=3}^{1} \cdots + \int_{y=2}^{0} \cdots$$

($\bar{B}$ ← $\frac{3}{x}*10^{-9}$; $(2*10^{-3})$ ← ثابت هيتقدر)

$$= K\left[\int_{x=1}^{3} dx\,\bar{a}_x \frac{1}{x}\bar{a}_z + \int_{y=0}^{2} dy\,\bar{a}_y * \frac{1}{3}\bar{a}_z + \int_{x}^{1} dx\,\bar{a}_x \times \cdots\right.$$